

## APPENDIX A

### UPDATES AND REVISIONS TO THE MRBCA TECHNICAL GUIDANCE

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The department seeks to maintain a viable, relevant, and effective Missouri Risk-Based Corrective Action (MRBCA) process with the flexibility necessary to meet changing environmental conditions and regulations. In addition, we expect that department staff and users of this guidance will identify areas of needed improvement over time. This appendix provides a framework for updating this guidance. Changes in the guidance will also be reflected in changes to the associated risk-based rules to the extent necessary to implement changes in the guidance. We envision ~~two~~three kinds of updates.

The first type of update addresses errors, omissions, clarifications or corrections to this guidance that do not involve substantive issues. These kinds of changes will be made as determined to be necessary by the Department of Natural Resources and as quickly as possible. We anticipate these changes to be handled by means of an “Errata Notice” that can be inserted into the document and that will be posted on the MRBCA web site maintained by the department.

The second type of update would be more substantive technical or policy issues that interpret or build upon the current technical guidance. Substantive changes to the guidance could also be made in this manner as long as they did not conflict with existing laws and regulations. These Technical and Policy Memoranda will also be posted on the MRBCA web site.

The ~~second~~third type of update will encompass a complete review that responds to changes in scientific knowledge, improved methodologies, and new and better information. Every three years, the department will initiate this systematic review and evaluation of this guidance. The first complete review and evaluation will begin three years from the date of final publication of this guidance. It should be staggered with any review of the risk-based corrective action guidance that covers the petroleum storage tanks so that the reviews are not on going in the same time period. Any changes made in the guidance will need to be conducted in step with any required regulatory procedures.

The review will be done through a public participation process and in concert with a stakeholder group that, at a minimum, is comprised of relevant federal, state and local agencies, regulated entities and their representatives, and interested citizens. The review process will identify and plan for areas of responsibility, a timeline for completion, quality control procedures, and a publication mechanism.

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## APPENDIX B

### DEFAULT TARGET LEVELS AND TIER 1 RISK-BASED TARGET LEVELS

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	All Soil Types and All Pathways	
	VOCs	Page 1 of 9
	SVOCs	Page 2 of 9
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<b>Table B-2</b>	<b>Default Target Levels</b>	
	Soil Type 1 (Sandy)	
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<b>Table B-4</b>	<b>Default Target Levels</b>	
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<b>Table B-52</b>	<b>Tier 1 Risk-Based Target Levels</b>	
	Residential Land Use	
	Soil Type 1 (Sandy)	
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<b>Table B-63</b>	<b>Tier 1 Risk-Based Target Levels</b>	
	Residential Land Use	
	Soil Type 2 (Silty)	
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<b>Table B-74</b>	<b>Tier 1 Risk-Based Target Levels</b>	
	Residential Land Use	
	Soil Type 3 (Clayey)	
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<b>Table B-85</b>	<b>Tier 1 Risk-Based Target Levels</b>	
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<b>Table B-96</b>	<b>Tier 1 Risk-Based Target Levels</b>	
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	Soil Type 2 (Silty)	
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<b>Table B-<del>107</del></b> <b>Tier 1 Risk-Based Target Levels</b>	Non-residential Land Use Soil Type 3 (Clayey) VOCs SVOCs Pesticides Metals Inorganics Total Petroleum Hydrocarbons and Fractions Chemicals common to both Departmental and Tanks MRBCA	Page 1 of 9 Page 2 of 9 Page 5 of 9 Page 7 of 9 Page 8 of 9 Page 8 of 9 Page 9 of 9
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<b>Table B-<del>129</del></b> <b>Tier 1 Risk-Based Target Levels</b>	Construction Worker Soil Type 2 (Silty) VOCs SVOCs Pesticides Metals Inorganics Total Petroleum Hydrocarbons and Fractions Chemicals common to both Departmental and Tanks MRBCA*	Page 1 of 9 Page 2 of 9 Page 5 of 9 Page 7 of 9 Page 8 of 9 Page 8 of 9 Page 9 of 9
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<b>Table B-<del>114</del></b> <b>Tier 1 Soil Concentrations Protective of Domestic Use of Groundwater Pathway**</b>	VOCs SVOCs Pesticides Metals Inorganics	Page 1 of 9 Page 2 of 9 Page 5 of 9 Page 7 of 9 Page 8 of 9

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| **Table B-1~~25~~ Chemicals without EPA Standard Method for Analysis and Chemicals without Practical Quantification Limit Listed**

| **Table B-1~~36~~ Saturated Soil Concentrations**

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\* Values associated with chemicals that are common to both the departmental and tanks MRBCA (such as benzene) are being posted separately. However, when final, this information will be included in this guidance.

\*\* Horizontal migration distance in the saturated zone is equal to zero.

Note that the chemicals in MRBCA Process for Petroleum Storage Tanks are highlighted.

**APPENDIX F**  
**ECOLOGICAL RISK ASSESSMENT CHECKLISTS**

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**Ecological Risk Assessment  
Screening Checklist for Potential Receptors and Habitat  
Level 1, Checklist A**

1. Is the boundary of the contaminated area less than ½ mile to a surface water body (stream, river, pond, lake, etc.)?
2. Are wetlands (as defined by the 1987 Corps of Engineers' Delineation Manual) on or adjacent to the site?
3. Are contaminated soils uncovered or otherwise accessible to ecological receptors and the elements?
4. Are there karstic features (see Ecological Risk Assessment Figure #2 for definition) on or within ½ mile of the boundary of the contaminated area?

Note: A professional opinion may be necessary to make this determination. The Missouri Environmental Geology Atlas (MEGA), published recently by the Department of Natural Resources, Geological Survey and Resource Assessment Division (GSRAD), provides several state-wide, karst-related data sets, as well as others related to geology and hydrology, in a geographic information system format that can assist in this determination. MEGA, including software to view the data sets, may be obtained from GSRAD by calling (573) 368-2125.

5. Are there federal or state rare, threatened, or endangered species on or within ½ mile of the contaminated area? Note: The ½ mile criterion does not apply to situations where a hydrological connection exists between the site and karstic features. Contact the Missouri Department of Conservation for state-listed species and the U.S. Fish and Wildlife Service for federally listed species.
6. Are there one or more environmentally sensitive areas (see Ecological Risk Assessment Figure #1 for definition) at or within ½ mile of the contaminated area?
7. Are commercially or recreationally important species (fauna or flora) on or within ½ mile of the contaminated area?

If the answer is "Yes" to any of the above questions, then complete Ecological Risk Assessment Checklist for Potential Exposure Pathways, Checklist B.

**Ecological Risk Assessment  
Screening Checklist for Potential Receptors and Habitat  
Level 1, Checklist B**

- 1.a.) Can contaminants associated with the site leach, dissolve, or otherwise migrate to groundwater?
- 1.b.) Are contaminants associated with the site mobile in groundwater?
- 1.c.) Does groundwater from the site discharge to ecological receptor habitat?

**Question 1:** Could contaminants associated with the site reach ecological receptors via groundwater?

- 2.a.) Is Non-Aqueous Phase Liquid (NAPL) present at the site?
- 2.b.) Is NAPL migrating?
- 2.c.) Could NAPL discharge occur where ecological receptors are found?

**Question 2:** Could contaminants from the site reach ecological receptors via migration of NAPL?

- 3.a.) Are contaminants present in surface soils?
- 3.b.) Can contaminants be leached from or be transported by erosion of surface soils?

**Question 3:** Could contaminants reach ecological receptors via erosional transport of contaminated soils or via precipitation runoff?

- 4.a.) Are contaminants present in surface soil or on the surface of the ground?
- 4.b.) Are potential ecological receptors on the site?

**Question 4:** Could contaminants reach ecological receptors via direct contact?

- 5.a.) Are contaminants present on the site volatile?
- 5.b.) Could contaminants on the site be transported in air as dust or particulate matter?

**Question 5:** Could contaminants reach ecological receptors via inhalation of volatilized contaminants or contaminants adhered to dust in ambient air or in subsurface burrows?

- 6.a.) Are contaminants present in surface and shallow subsurface soils or on the surface of the ground?
- 6.b.) Are contaminants found in soil on the site taken up by plants growing on the site?
- 6.c.) Do potential ecological receptors on or near the site feed on plants (e.g., grasses, shrubs, forbs, trees, etc.) found on the site?
- 6.d.) Do contaminants found on the site bioaccumulate?

**Question 6:** Could contaminants reach ecological receptors via direct ingestion of soil, plants, animals or contaminants?

- 7.a.) Are there karstic features (see Ecological Risk Assessment Figure #2 for definition) on or within ½ mile of the contaminated area?
- 7.b.) Is there a hydrogeological connection between the site and karstic features such as seeps, springs, streams or other surface water bodies?

**Question 7:** Could contaminants reach ecological receptors via transport through a karst system?

Note: ~~Answers to questions 7b and 7 must be supported by a statement from a Registered Geologist or Professional Engineer with geology practice. A professional opinion may be necessary to answer 7.a, 7.b, and Question 7.~~ –The Missouri Environmental Geology Atlas (MEGA), published recently by the Missouri Department of Natural Resources, Geological Survey and Resource Assessment Division (GSRAD), provides several state-wide, karst-related data sets, as well as others related to geology and hydrology, in a geographic information system format, that can assist in answering these questions. MEGA, including software to view the data sets, can be obtained from GSRAD by calling (573) 368-2125. The determination of proximity to karst features/topography under questions 7b and 7 of Checklist B does not always require a field determination. However, in some cases, a field determination may be appropriate.

If the answer to one or more of the seven above questions is “Yes”, the department may require further assessment to determine whether the site poses an unacceptable risk to ecological receptors.

## **Ecological Risk Assessment**

### **Figure #1: Environmentally Sensitive Areas**

An Environmentally Sensitive Area is of special significance due to its flora or fauna, the sensitive nature of its natural features, historical considerations, or other reasons associated with the environment.

Examples of environmentally sensitive areas include, but are not limited to, the following:

- National and state parks,
- Designated and proposed federal and state wilderness and natural areas,
- Endangered, rare, and threatened species habitat as designated by the U.S. Department of the Interior or the Missouri Department of Conservation,
- National monuments,
- National and state historic sites,
- National and state lakeshore and river recreational areas,
- Federal or state designated scenic or wild rivers,
- Habitat of federal or state designated or proposed endangered, rare, or threatened species, and species under review as to their endangered, rare, or threatened status,
- National and state preserves and forests,
- National and state wildlife refuges,
- Critical fish and shellfish spawning areas,
- Critical migratory pathways and feeding areas for anadromous fish species within river reaches or areas in lakes where such species spend extended periods of time,
- Terrestrial areas used for breeding by large or dense aggregations of faunal species,
- State lands designated by the Missouri Department of Conservation for wildlife or game management,
- Wetlands as defined by the 1987 Corps of Engineers Delineation Manual and
- Outstanding state resource waters as designated by the Missouri Clean Water Commission.

## **Ecological Risk Assessment**

### **Figure #2: Karst Features**

Karst: A distinctive set of geomorphic landforms resulting from the development of extensive subsurface solution channels and caves in carbonate rocks (Boulding, 1995).

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## APPENDIX L DEFINITIONS

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**7Q10:** the average minimum flow of a stream for seven consecutive days that has a probable recurrence interval of once-in-ten years.

**Activity and Use Limitations (AULs):** mechanisms or controls that ensure that ~~pathways of~~ exposure pathways to COCs, through current or reasonable future uses, are not completed for as long as the COCs pose an unacceptable risk to human health, public welfare or the environment.

**Acute water quality criterion for the protection of aquatic life:** the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1 hour) without harmful effects. Acute criteria apply to unclassified waters and to classified waters at the edge of the zone of initial dilution.

**Additivity of risk:** sum of risk for each chemical and each route of exposure.

**Chronic water quality criterion for the protection of aquatic life:** the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without harmful effects. Chronic criteria apply to classified waters only at the edge of the mixing zone.

**Cumulative site-wide risk:** sum of risk for all chemicals and all ~~routes of exposure~~exposure pathways.

**Domestic consumption:** ingestion and inhalation of vapors generated by indoor water use activities such as showering and washing.

**Exposure domain:** area that contributes chemicals that result in exposure to a particular receptor by a specified route of exposure.

**Exposure Pathway:** The course a chemical takes from a source to the receptor. An exposure pathway describes a unique mechanism by which an individual or population is exposed to chemicals originating from a site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) or media (in cases of intermedia transfer) also is included. The exposure pathway is considered complete if there are no discontinuities in or impediments to movement from the source of the contaminant to the receptor.

**Hydraulic conductivity:** the volume of water at the existing kinematic viscosity that will move in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.

**Long-term stewardship:** an appropriate system of controls, institutions and

information necessary to fully protect human health, public welfare and the environment into perpetuity.

**Mixing zone:** an area of dilution of effluent in the receiving water beyond which chronic toxicity criteria must be met [10 CSR 20-7.031(1)(N)].

**Off-site:** Areas beyond the site that potentially become contaminated.

**Practical Quantitation Limit:** Lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

**Receptor:** An organism that receives, may receive, or has received exposure to a COC as a result of a release. Under the MRBCA program, human receptor refers to a resident child, resident adult, non-resident adult, or construction worker.

**Remediating party:** all private entities and their designees, collectively and generically, ~~involved with the site~~, such as responsible parties, development interests, landowners and others directly involved in the ~~evaluation and management~~remediation of a particular contaminated site.

**Sensitivity Analysis:** Evaluation of the calculated risk or target levels for different alternatives of possible input parameters.

**Site:** areal extent of contamination.

**Surficial soil:** from 0-3 feet below ground surface (bgs).

**Subsurface soil:** from 3 feet bgs to the water table or, if the groundwater is shallow, less than 15 feet bgs below the water table.

**Unrestricted use levels:** chemical concentrations at which soil and groundwater at a site are safe for residential land use and domestic use of groundwater.

## APPENDIX M

### SITE-SPECIFIC BACKGROUND CONCENTRATIONS

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#### INTRODUCTION

“Background” can be defined as concentrations of chemicals in soils or groundwater in the immediate area of a contaminated site. Background concentrations can be naturally occurring (the concentration is not due to a release of chemicals from human activities), or anthropogenic (the presence of a chemical in the environment is due to human activities, but not the result of site-specific use, waste or product release, or industrial activity).

Naturally occurring metals and other chemicals are found in natural soils and groundwater at varying concentrations, depending upon the topography, geology, geography and physical, biological, and chemical properties of the soil and groundwater. The source of these chemicals is typically from geomorphological processes, such as erosion, weathering, and dissolution of mineral deposits.

Anthropogenic impacts include lead from automobile emissions, arsenic from use of defoliants, pesticides in agricultural areas, and poly-nuclear aromatic hydrocarbons resulting from combustion of hydrocarbons. For anthropogenic impacts, the chemicals usually result from the use of a product in its intended manner and may be present at low levels over large areas.

In addition to natural and anthropogenic sources, chemical concentrations in soil and groundwater may be the result of on-site activities at contaminated sites. The assessment screening strategy and remediation strategy for cleanup of such sites, as well as implementation of institutional controls, requires that background concentrations of chemicals be determined in order to ascertain the extent to which the contamination can be attributed to on-site activities.

The determination of “background” contains two fundamental challenges. First, “background” inherently implies natural variability, thus creating a distribution or a range that varies with the spatial distribution of the samples. Defining a site-specific background concentration level for background concentrations is therefore difficult. Second, soil and groundwater are heterogeneous in nature. The need to replicate the “background” as closely to the site characteristics as possible, minus the on-site activity, poses a number of challenges related to the selection of the background site as well as the sampling plan.

Determination of background concentrations for the chemicals detected at a site is very important for establishing the site-specific chemicals of concern (COC) for which cleanup levels must be determined. Because chemicals not related to the past or current site-related activities may be present at a site, it is important to determine the background concentrations for those specific chemicals. Further, for site-related chemicals, if the background concentrations are greater than the target cleanup levels, a decision must be

made as to whether the site should be cleaned up to background levels or to risk-based levels. It may not be feasible or practical to clean up the site to target cleanup levels due to cost-effectiveness, technical impracticability, and the potential for recontamination of remediated areas from surrounding areas with elevated background concentrations.

## **METHODOLOGY**

Prior to determining the site-specific background concentration for any chemical, the following approach should be used to determine if background determination is necessary.

First, determine whether the chemicals detected on-site are due to the site or nearby activities. To eliminate chemicals not related to site activities, historical research and interviews should be performed to determine the past and current activities for the site and adjacent properties.

The department has established three levels of cleanup criteria:

- a. Default Target Levels,
- b. Tier 1 Risk-Based Target Levels, and
- c. Site-Specific Target Levels.

For soil and groundwater, determination of background concentrations is necessary for chemicals that exceed both Default Target Levels and appropriate Tier 1 risk-based target levels.

For some chemicals, the only applicable pathway may be soil to groundwater. If so, the Synthetic Precipitation Leaching Procedure (SPLP) may be used to determine if the chemical concentration in the soil has the potential to leach from the soil and migrate into the groundwater and cause groundwater impacts at levels above the approved groundwater target level for that chemical. The SPLP analysis should be performed on a number of soil samples with the highest levels of impact for the specific COC and the results compared to the target groundwater levels. The number of samples for SPLP analysis would be determined on a site-specific basis and approved by the department, considering the size of the impacted area, heterogeneity of the impacted soils, and other site conditions. If all SPLP results are below the target groundwater levels, then those specific chemicals do not need to be considered in determining the cleanup objectives for the site.

The background area should be on the site or in close proximity to the site. It must be shown that the area selected has not been impacted by historical or current site activities, nearby activities, or fill materials that share similar physical, chemical, biological, and geological characteristics with the site.

In the selection of a background area, the following points must be taken into consideration:

- a) **Background soil samples must be taken from similar soil characteristics.** Because of the heterogeneity of soils, it may be necessary to establish more than one background concentration for a COC. Soils are essentially heterogeneous, and their particle size, pH, salinity, cation exchange capacity, and soil organic carbon content vary spatially – both vertically and horizontally. It may be necessary to determine background concentrations for different stratigraphic intervals or for areas of impact that are widely separated by non-impacted areas.

Because of these considerations, it is important to ensure that factors that affect the concentration of chemicals in the soil are considered when collecting samples from the site and off-site. As much as possible, soil samples must be taken from identical soil depths, identical soil textures, identical pH values, and at the same time of the year as for the impacted soil horizons.

Grid sampling can be an effective way of obtaining representative background samples; however, care must be taken to avoid including samples from impacted areas, or samples from areas or intervals that have significantly dissimilar physical, chemical, and biological characteristics.

- b) **Background water samples must be taken from areas of similar groundwater characteristics.** To determine background concentrations for groundwater, sampling must be conducted for a minimum of one year in four consecutive quarters, unless a different schedule is approved by the department. The wells used in the background determination must be:
- Located in areas not affected by the release,
  - Screened in the same geologic unit that is contaminated on site,
  - Located up gradient from the release area(s),
  - Sufficient in number to account for all possible off-site releases, and
  - Sufficient in number to adequately characterize the hydrogeologic setting.
- c) **Location of the background area is important.** Background area must reflect the soil and groundwater characteristics at the site, and the background area must be in close proximity to the site, without having been impacted by site or nearby activities. Background concentrations of chemicals can vary significantly from metropolitan to non-metropolitan areas.
- d) **Evaluation of land use and prior history is important.** Information of prior land use at and near the site should be collected to determine if prior human activities contributed to background concentrations and to the presence of certain chemicals unrelated to activities at the site or from nearby sites. Similarly, if the site contains fill materials, it is important to recognize the potential for contaminants because of the fill materials, rather than because of site or nearby activities.
- e) **An appropriate number of samples must be taken.** Sample collection must take an appropriate number of samples for the statistical method being used and

considering site-specific conditions. The sampling strategy should be designed to obtain background levels that are truly representative of the site. Care should be taken if composite sampling will be used to reduce the total number of samples, such that the composites should represent background conditions and not create biased results. The number of samples to be obtained must be supported by a valid sampling strategy approved by the department.

Any statistically valid approach approved by the department can be used to develop site-specific background values. The approach must be appropriate for the characteristics of the data set being evaluated.

## **APPROVAL**

The basis for approval of a site-specific background concentration for a specific chemical is determined by a review of the following criteria:

- a) Evaluation of all samples used in the background data set to determine if appropriately representative of site conditions based on locations, depths, number of samples, sampling methods, and laboratory analysis methods.
- b) Evaluation from a toxicological and risk-assessment standpoint to determine if the background levels are inherently too high for a potential exposure from the intended future land use.
- c) Verification of statistical methodology, assumptions used and results obtained.

## **APPLICATION**

An approved background concentration of a chemical may be used on a site-specific basis for the assessment screening strategy, or as the cleanup level under all three standards (Default Target Levels, Tier 1 risk-based target levels, and site-specific target levels). In some cases, the site-specific background concentrations may be higher than the health-based cleanup level. For example, the health-based concentration of a chemical in soil may be lower than the naturally occurring concentration of that chemical in a certain soil type or location. Therefore, it would not be practical to clean up to the health-based level.

If the site-specific background concentration for a specific chemical is higher than the levels detected in all the samples obtained and analyzed from the site, then that chemical can be dropped from consideration in the site cleanup goals.

**APPENDIX N**

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**CLEANUP LEVELS FOR SURFACES AND BUILDING INTERIORS**

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**ASBESTOS ABATEMENT**

Clearance criteria for asbestos abatement projects that occur within the confines of a building are specified at 10 CSR 10-6.240(H). The department must approve any deviations from these clearance criteria.

**LEAD ABATEMENT**

For lead abatement projects that occur within the confines of a building the clearance criteria for dust wipe samples are as follows;

Residential

- 50 micrograms of lead per square foot for uncarpeted floors
- 250 micrograms of lead per square foot for windowsills
- 800 micrograms of lead per square foot for window wells

Non-Residential

- 200 micrograms of lead per square foot for floors
- 500 micrograms of lead per square foot for windowsills
- 800 micrograms of lead per square foot for window wells

The department must approve any deviations from these clearance criteria.

Note: The Residential clearance criteria are derived from 40 CFR 745.65(b), as proposed in the June 3, 1998 *Federal Register*. The Non-Residential clearance criteria are derived from the Missouri Office of Administration's Lead Abatement Specifications.

**PCB-CONTAMINATED STRUCTURES**

For PCB-contaminated concrete, the cleanup criteria shall be 10 ppm for destructive core sampling and 10  $\mu\text{g}/100\text{ cm}^2$  for surface wipe sampling. Because concrete is permeable, destructive core sampling or its equivalent is required for PCB-contaminated concrete. The wipe sampling may be optional. The department may consider higher cleanup criteria for PCB-contaminated concrete if the concrete is effectively encapsulated with an impermeable surface coating. In this case, a restrictive covenant would be required to ensure long-term maintenance of the surface coating.

For PCB contamination on impervious solid surfaces, such as a metal wall, the cleanup criteria shall be 10  $\mu\text{g}/100\text{ cm}^2$  for a surface wipe sample.

Note: The 10  $\mu\text{g}/100\text{ cm}^2$  criteria are derived from the USEPA's PCB Spill Cleanup Policy, 40 CFR 761, Subpart G. The USEPA's Spill Cleanup Policy does not prescribe destructive core sampling for PCB-contaminated concrete. Wipe sampling alone is not

sufficient to verify cleanup of PCB-contaminated concrete. It is possible to remove PCBs from the surface of the concrete through solvent washing and leave behind significant PCB contamination deeper in the concrete. With time, PCBs may again migrate to the surface, creating a potential exposure. This scenario illustrates the need for destructive core sampling.